

MARSHALL SPACE FLIGHT CENTER NASA FACULTY FELLOWSHIP PROGRAM (NFFP) RESEARCH/TASKS AVAILABLE FOR SUMMER 2004

Engineering Directorate

TITLE OF RESEARCH/TASK

Research and investigation/assessment of advanced computing technology tools and products for applications and solutions to real issues in avionics systems. Soft computing technologies to be considered include application of biology inspired techniques, probabilistic methods, evolvable/reconfigurable computing, and relevant others to be identified by the sponsor.

BRIEF DESCRIPTION OF RESEARCH/TASK

This research task will require the researcher to investigate available software tools. Such factors that will need to be assessed for each product and technology include its usability, applicability, and feasibility in addressing existing problems in the avionics domain. The sponsor and the researcher will identify the candidate products, technologies, and existing avionics issues to be investigated and assessed.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

The required discipline for the researcher is software engineering, computer science, computer engineering, mathematics, physics, or applicable engineering and math sciences. It would be imperative for the researcher to have experience in two or more of the following soft computing technologies: genetic algorithms, artificial intelligence, neural networks, fuzzy logic, and probability and statistics.

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DEPARTMENT

ED10 Avionics

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TITLE OF RESEARCH/TASK

Advanced Avionics Architecture Development

BRIEF DESCRIPTION OF RESEARCH/TASK

The task provides the identification of candidate avionics data communication and control networks which may be employed in multiple, redundant architectures, providing possible simultaneous access to sensors, effectors, and health management nodes on "black boxes". The task is to define that which is necessary to construct a test, demonstration, and simulation system for use in evaluating such networks.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Electrical engineering or physics

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Avionics

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TITLE OF RESEARCH/TASK

Engine Health Management and Control Systems Development

BRIEF DESCRIPTION OF RESEARCH/TASK

Participate in the development of engine health management and control systems requirements and in the specification of laboratory facilities needed to perform development and test of such systems. Areas to be considered consist of avionic system architectures and sensing, health management and control requirements, hardware design solutions, software verification and validation, hot fire data analysis, and system simulation.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Electrical and/or Computer Engineering, Computer Science, Physics

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Avionics

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TITLE OF RESEARCH/TASK

Investigation and assessment of software products, software Commercial-off-the-shelf (COTS) tools, software technologies, and soft computing technologies for insertion into the flight software development processes.

BRIEF DESCRIPTION OF RESEARCH/TASK

This research task will require the researcher to investigate software products, software commercial-of-the-shelf (COTS) tools, software technologies, and soft computing technologies for use with existing embedded flight software development data and processes. Such factors that will need to be assessed for each product and technology include its usability, applicability, and feasibility in our domain. The sponsor will identify the candidate products and technologies to be investigated and assessed.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

The required discipline for the researcher is software engineering or computer science. It would also be beneficial for the researcher to have some experience in soft computing (i.e., artificial intelligence, neural networks, fuzzy logic, and probability and statistics) technologies.

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DEPARTMENT

ED 10 Avionics

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TITLE OF RESEARCH/TASK

Advanced Electronic Packaging Technology

BRIEF DESCRIPTION OF RESEARCH/TASK

Assist MSFC Avionics Department with implementation of advanced packaging concepts. Assist in determining design of research test vehicles for evaluating advanced packaging technologies. Consult with packaging personnel to identify candidate technologies for future research investments.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Advanced Electronic Packaging Technologies - Electrical/Mechanical/Aerospace Engineering

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DEPARTMENT

Avionics/ED10

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TITLE OF RESEARCH/TASK

Integrated Avionics, Health Management, and Controls Development and Simulation Testing

BRIEF DESCRIPTION OF RESEARCH/TASK

Develop an Integrated Avionics, Health Management, and Controls (IAHM&C) architecture for space transportation vehicle development and establish requirements for the system as well as a plan for its development and simulation testing. Determine requirements for hardware-in-the-loop

(HIL) testing in concert with flight simulations and develop a phasing plan for facilitating the Marshall Avionics System Testbed (MAST) laboratory renovation.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Electrical Engineering, Computer Engineering, Computer Science, Physics

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DEPARTMENT

Avionics

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TITLE OF RESEARCH/TASK

Smart Adaptive Structures

BRIEF DESCRIPTION OF RESEARCH/TASK

In-space solar sail technologies are being investigated. The laboratory consists of a 105' deployable boom which replicates one support member for the sail. The boom is a light weight, flexible, lightly damped structure that is deployable to various lengths. Boom dynamic characteristics, sensing technologies, passive and active boom control methodologies, and boom scaling laws will be developed and investigated under this task. Analytical modeling and experimental verification in each of these areas will be pursued.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Electrical, Mechanical, or Aerospace Engineering

MSFC SPONSOR

<u>NAME</u>	<u>MAIL CODE</u>	<u>PHONE</u>	<u>E-MAIL ADDRESS</u>
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Jerry Oakley	ED27	256-544-1118	Jerald.D.Oakley@nasa.gov

DEPARTMENT

Structures, Mechanics, & Thermal Department

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TITLE OF RESEARCH/TASK

Characterization of Composite Material for Radiation Shielding

BRIEF DESCRIPTION OF RESEARCH/TASK

The above research will require the Summer Faculty Fellow to perform the following:

1. Continue to fully characterize mechanical & physical properties of polyethylene, fiber-reinforced epoxy matrix composite at various thicknesses.

2. Generate design allowable data for "A" and "B" basis statistical significance. This is to be generated from above mentioned mechanical and physical property data.
3. Perform finite element modeling of design lay-ups to optimize design for a space structure. Maximum protection vs. weight.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Experience in experimental characterization of composite materials, structural analysis and design using finite element modeling, knowledge of fiber reinforced polymers, and versatile in computer programming.

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DEPARTMENT

Materials, Processes and Manufacturing

TITLE OF RESEARCH/TASK

Plasma Diagnostics with Applications to Electric Propulsion

BRIEF DESCRIPTION OF RESEARCH/TASK

The faculty member will collaborate with a team of MSFC researchers engaged in exploring plasma phenomena associated with high power electric propulsion devices. The focus of the research will be on diagnostics that allow determination of plasma properties in a thruster plume as well as inside plasma generation sources. In addition, the interaction of a thruster plasma with materials and systems will also be investigated.

Diagnostic tools used will include Langmuir probes, emissive probes, microwave interferometers, and Laser Induced Fluorescence. The faculty researcher will be involved with the creation and application of the diagnostics as well as advancing the capabilities of the diagnostic to yield higher resolution. The use of multiple diagnostics will be required to scan the wide range of plasma temperatures and densities that are generated in the multiple sources used at MSFC.

The summer activities will take place in several different laboratories across the center including the Space Environmental Effects and Propulsion Research Lab facilities. The data gathered during the summer activity will be used to improve the efficiency of electric propulsion devices as well as lengthen the useable life of materials that are in contact with high energy plasma particles.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

A background in Physics, Mechanical Engineering, or Electrical Engineering is important.

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DEPARTMENT

Materials, Processes, and Manufacturing (MP&M)

TITLE OF RESEARCH/TASK

Friction Stir Welding Model, Microstructural Aspects

BRIEF DESCRIPTION OF RESEARCH/TASK

The friction stir welding (FSW) process is a major new welding process suitable for many metals which give problems in fusion welding. This includes the 2195 aluminum-lithium alloy of the Super-Lightweight Space Shuttle External Tank, for which FSW is under implementation. This study supports FSW technology by creating a base of understanding to be used as a diagnostic tool and as a springboard for process design advances.

Contrast differences observed within the recrystallized part of the FSW weld may be caused by local crystal orientation differences (texture), differential contamination entrainment from the weld seam, differential phase transformations brought about by thermal history differences, or structural differences brought about by different strain histories. Last summer's study tentatively showed a correlation of orientation differences (texture) with FSW flow fields without a need to invoke strain induced structural differences.

This task comprises further examination of existent specimen structures and an attempt to understand the structures via theoretical models.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Dislocation theory, Mechanical Metallurgy

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DEPARTMENT

Materials, Processes, & Manufacturing (ED30)

TITLE OF RESEARCH/TASK

Friction Stir Welding Model, Force Aspects

BRIEF DESCRIPTION OF RESEARCH/TASK

The friction stir welding (FSW) process is a major new welding process suitable for many metals which give problems in fusion welding. This includes the 2195 aluminum-lithium alloy of the Super-Lightweight Space Shuttle External Tank, for which FSW is under implementation. This study supports FSW technology by synthesizing a comprehensive model to be used as a diagnostic tool and as a springboard for process design advances.

Measurements of FSW tool forces, i.e. plunge force, translational force, and lateral force, are sparse, and what measurements exist exhibit a complex and difficult to understand dependence of force upon weld parameters. To our knowledge no theoretical models exist that could explain these force-parameter dependences with the exception of some models developed at MSFC with the assistance of collaborators. These models are in the early stage of development and need further thought and experimental validation.

This task comprises examination of the concepts upon which the embryonic MSFC models of the dependences of FSW forces upon weld parameters depend, possible modifications of these models, and accumulation of data for validation of the models.

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Plasticity theory, Mechanical Metallurgy

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DEPARTMENT

Materials, Processes, & Manufacturing (ED30)

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TITLE OF RESEARCH/TASK

Development of Materials and Processes Technical Information System, MAPTIS, database for materials knowledge.

BRIEF DESCRIPTION OF RESEARCH/TASK

Assisting other programmers in the conversion of the MAPTIS database to a XML web based system and development of appropriate search engines to be used. MAPTIS is moving from a Digital VAX system and has recently been released in an XML format, but additional work is still required to fully integrate new features and technologies. MAPTIS is an electronic database of test data for materials including properties, toxicity ratings, flammability, thermal vacuum stability and many other material characteristics

DISCIPLINARY FIELDS REQUIRED/APPLICABLE FOR RESEARCH/TASK

Understanding of materials sciences, VAX/Oracle experience, and XML programming experience.

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DEPARTMENT

Materials, Processes and Manufacturing

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